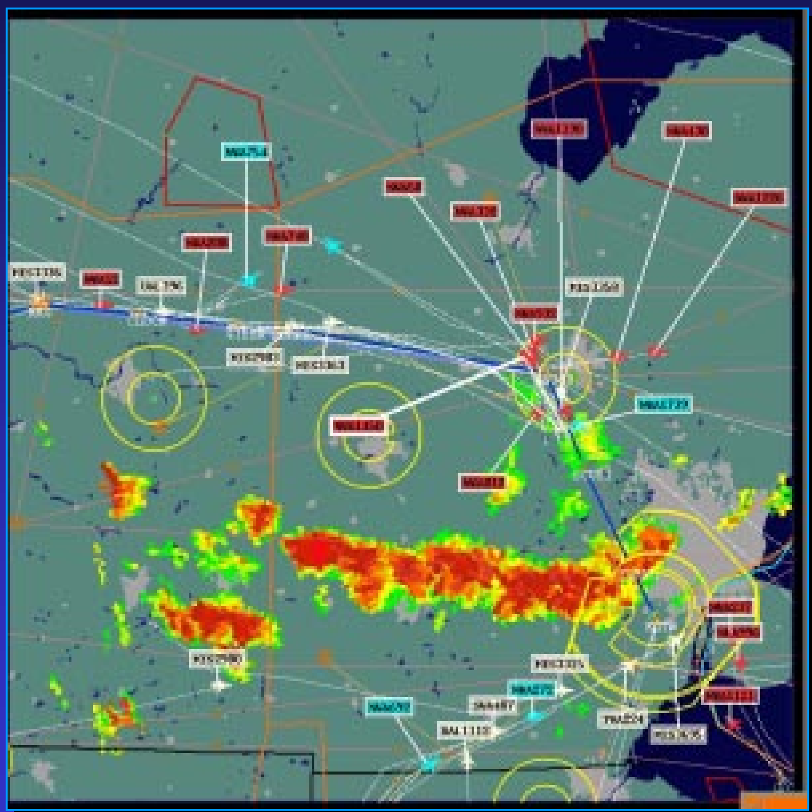
Collaborative Arrival Planning



Lockheed Martin Team

AATT TO13

Airline Influenced Arrival Scheduling

Benefits

The Purpose

- Through dialogue with major airspace users (airlines) during work on the RTCA TF3 – Free Flight Task Force and with the Collaborative Decision Making Working Group . . . .

. . . . "There is broad consensus that it would be economically beneficial for airlines to be allowed to prioritize and adjust the arrival (landing) sequence of their flights." . . . .

- This study set out to examine this perception and establish if economic benefit really exists and quantify any potential savings

The Team

Lockheed Martin

Management & Data Systems

Northwest Airlines

Oak Ridge National Laboratory

What Was Studied

- Northwest Airline Operations – April 06, 07, 08, 1998
- Focus on Hub Operations at:
  - Detroit
  - Memphis
  - Minneapolis

Involving 3,457 Flight Operations
Transporting 219,969 Passengers

The Data

- Operational Data obtained from Northwest
  - Flight leg data for NWA and its two feeder airlines
  - Flight delay causes*
  - Passenger ticket data for the three hub airports (incoming and outgoing)
  - Passenger connection times
  - Crew patterns for pilots and flight attendants
  - Aircraft and crew schedule and minimum turn time data
  - Aircraft tail number, type and model information and seat capacity
  - Flight leg load factors
  - Aircraft performance data
- Although the focus was the hub operations at DTW-MEM-MSP, all Northwest flight operations during the 3-day period had to be included in the study in order to compute downline connectivity

* Not used in the Model

What Was Done

- A Cost Model was constructed for each of the three hubs using the actual operating times (OOOI) for each flight
- The model built connections for:
  - Each passenger flowing through the hubs
  - Airplane and crew connection trees for all flights
- The airplane and crew patterns were also tracked for all their down-line impacts and the total down-line delay minutes calculated for all subsequent flight legs
- Cost Factors were applied and the cost component for any misconnected passengers and for the total delay minutes were summed and the overall cost Impact to each flight

Model Limitations

- The model did not deal with:
  - Complete simulation of the re-sequencing of flights in the arrival stream
  - Costs associated with gate occupancy impacts for early flight arrivals or the delays and additional taxi in times caused by late departing flights
  - Calculating if moving up a line of flight could avoid or reduce delays caused by crew late arrival on last flight of the day. Where a late arrival causes a crew rest delay to the next days departure
  - Determining if the number of overnight passengers could be reduced by moving flights forward

How the Model Calculated

- A Connectivity Window was created by:
  - Adding and subtracting 5 minutes to/from the actual in-time
  - Over a range of time ±20 minutes of actual in-time for all flights
- Each of these 5 minute windows provided a snapshot of the operating cost the airline would have incurred had flights operated at these adjusted times
- For the purposes of the analysis, the assumption was made that for both turbojet and turboprop airplanes, a time window for speed-up/slow-down of around the nominal landing time was:
  - –10 (early) to +10 (later) minutes

The Baseline

- Using these cost results, the total cost potential for moving flights was then computed from the sum of the passenger misconnection costs at the hub, plus all the differences in flight delay departing the hub, plus all the down-line delay changes.

- The analysis produced the following Cost Model data for th

	Total No. Passenger Misconnects	Total No. Flight Legs Delayed	Total Delay Minutes	Psgr Cost	Total Delay Cost	Total Cost
Baseline Cost	5,773	6,512	25,205	$153,734	$300,295	$454,030
5-Minute Move-Up	4,162	5,637	19,411	$110,834	$232,803	$343,637
10-Minute Move-Up	2,987	5,058	14,540	$79,543	$173,244	$252,788
20-Minute Move-Up	1,968	4,433	9,241	$52,407	$111,376	$163,783

Annualized Numbers Reality Check

Baseline Cost	$454,030
10-Minute Move-Up	$252,788
Cost Avoidance	$201,330
Simple Annulization	$24,495,150

The approach to reality was to take a very conservative approach:
view NWA daily totals by:

Percentage On-Time Arrivals

Adjusted for the maximum fuel cost for speed up slow down ($170 per f flight event)

Daily Total Flights	Percentage On-Time	Total Saving	Average Per Flight	Adjusted for Fuel Cost	Average Per Flight
1153	65.8	$94,837	$82	$58,287	$51
1153	81.4	$60,080	$52	$27,270	$24
1153	85.1	$46,324	$40	$16,574	$14

Annualized Savings

Applying the average saving per flight to U.S. Industry Hub Operations as reported in the DOT Oct-99 On-Time Performance Report (More than 100 operations/airline/hub) adjusted for the percentage of *81%* for slot flight swaps achieved in the NWA model:

		Percentage On-Time		
Airline	**Total Flights**	**65.10%**	**81.40%**	**85.10%**
AAL	855	$43,237	$20,229	$12,295
COA	1138	$57,529	$26,915	$16,358
DAL	1062	$53,662	$25,106	$15,259
TWA	339	$17,137	$8,018	$4,873
UAL	1111	$56,167	$26,278	$15,971
USA	784	$39,654	$18,553	$11,276
NWA	832	$42,058	$19,677	$11,959
	Daily Total	**$309,445**	**$144,776**	**$87,991**
	Annual Total	**$112,947,325**	**$52,843,233**	**$32,116,749**
	81%	**$91,487,333**	**$42,803,019**	**$26,014,567**